

REMARKS

By this amendment, applicants have amended claims 1 and 13 to eliminate the informalities noted by the Examiner in numbered section 2 of the Office Action.

Applicants note the indication in numbered sections 1 and 5 of the Office Action that the Terminal Disclaimer filed June 12, 2006 has been disapproved and not accepted. The Examiner is thanked for recognizing the clerical error in the Terminal Disclaimer with respect to the patent number. The Terminal Disclaimer filed June 12, 2006 is, therefore, withdrawn and Applicants are submitting herewith a corrected Terminal Disclaimer correctly identifying Patent No. 6,764,950.

In view of the foregoing amendments to claims 1 and 13, reconsideration and withdrawal of the objections to claims 1 and 13 in numbered section 2 of the Office Action are requested.

In view of the attached Terminal Disclaimer, reconsideration and withdrawal of the obviousness-type double patenting rejection of claims 1-20 in numbered section 3 of the Office Action are requested. The Terminal Disclaimer has been filed in order to advance the prosecution of the application and is not an admission of the propriety of the double patenting rejection.

Claims 1-20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,181,012 to Edelstein et al. in view of U.S. Patent No. 6,136,680 to Lai et al. and U.S. Patent No. 6,171,957 to Maekawa. Applicants traverse this rejection and request reconsideration thereof.

The present invention relates to a method of fabricating a semiconductor integrated circuit device in which a copper wiring layer is formed in a hole and groove of first and second insulating films using an electroplating procedure. According to the present invention, a hydrogen or ammonia plasma treatment is

performed to at least the inner surfaces of the holes and grooves and a copper seed layer is formed over a barrier layer inside the groove and hole by copper sputtering with a copper target having a purity of 99.999% or more.

The patent Edelstein discloses a copper interconnection structure incorporating a metal seed layer. As recognized by the Examiner, the patent does not disclose performing a hydrogen or ammonia plasma treatment to at least the inner surfaces of the holes and grooves and forming a copper seed layer over a barrier metal layer inside and outside the groove and hole by copper sputtering with a copper target having a purity of 99.999% or more, as presently claimed. To the contrary, the Edelstein et al. patent specifically discloses using a copper alloy with 0.25 to 1.5 atomic percent Sn or In as the seed layer. Other non-copper metal alloy seed layers are also disclosed. The Edelstein et al. patent recommends the incorporation of Sn or In in the copper alloy seed layer rather than using pure copper since Edelstein et al. indicate that the electromigration life of Cu (Sn) or Cu (In) greatly exceeds that of pure Cu. See, column 8, lines 50-53 of Edelstein et al. Accordingly, the Edelstein et al. patent actually teaches away from forming a copper seed layer over the barrier metal layer inside and outside the groove and the hole by copper sputtering a copper target having a purity of 99.999% or more, as presently claimed.

The patent to Lai et al. has been cited by the Examiner for its teachings in connection with ammonia or hydrogen plasma treatment. However, this patent does not remedy one of the basic deficiencies of Maekawa, i.e., the Lai et al. patent does not suggest forming a copper seed layer over the barrier metal layer inside and outside the groove and hole by copper sputtering in a copper target having a purity of 99.999% or more, as presently claimed.

The Maekawa patent discloses forming a copper film by sputtering a copper target having a purity of 99.999 wt. % or higher. However, sputtering this copper target is used for forming a copper film, not for forming a seed layer on which a copper film is electroplated. Forming the copper film itself by sputtering in Maekawa is quite different than forming a copper seed layer and then electroplating a copper film as in Edelstein et al. and as in the present invention. The use of a copper target of 99.999% purity in Maekawa does not suggest the formation of a seed layer using such a copper target. This is particular true in view of the teachings of Edelstein et al. to use a copper alloy with 0.25 to 1.5 wt. % Sn or In to improve the electromigration life time.

Since the Maekawa does not relate to the formation of a seed layer and since the Edelstein et al. patent teaches away from using a pure copper seed layer, it is submitted there would have been no motivation to combine the teachings of Edelstein et al. and Maekawa.

For the foregoing reasons, the presently claimed invention is patentable over the proposed combination of references.

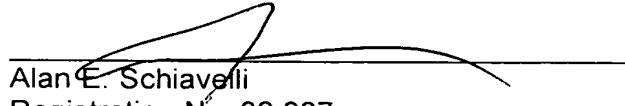
In view of the foregoing amendments and remarks and the attached revised Terminal Disclaimer, favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli,

Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 501.39932CX1),
and please credit any excess fees to such deposit account.

Respectfully submitted,

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